DEFENSE ANALYSIS CHALLENGES FOR MODELING AND SIMULATION

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LISTEN TO THE EVOLVING LANGUAGE OF THE DEFENSE DEBATE

-"ASYMMETRIC" THREATS.
-ADAPTIVE THREATS.
-UNCERTAINTY" AND "CHANGE". - INFORMATION BASED WARFARE.
-EFFECTS BASED WARFARE.
-EMERGENT BEHAVIOR.
-PRECISION ENGAGEMENT.
•"UNINTENDED CONSEQUENCES".
-SYNCHRONIZING ALL INSTRUMENTS OF NATIONAL POWER

THE LANGUAGE OF "OPEN SYSTEMS".

THE LANGUAGE OF COMPLEXITY SCIENCE.

BEHAVIORS, SYSTEMS, STRUCTURES EMERGE FROM

INTERACTIONS AMONG INGREDIENTS; THEY ARE

"CONSEQUENCE" MORE THAN "CAUSE".

OPEN SYSTEMS

- **THERMODYNAMICALLY, ENERGY CROSSES THE SYSTEM BOUNDARY.**
  - **"ENERGY" INCLUDES MENTAL ENERGY:**
    - **INFORMATION, CREATIVITY, PERCEPTION, MOTIVATION.**

- **STRUCTURE & BEHAVIOR "EMERGES" - ATTRACTORS**
  - **WHAT WE SEE AS "SYSTEMS" APPEAR AND ENDURE AND CAN CHANGE THEMSELVES TO SATISFY MOTIVATIONS ABILITIES AN OF THEIR INGREDIENTS. .**

- **CHARACTERIZED BY STATE CHANGES: LIKE WATER**
  - **FIXED (SOLID) - "LOCKED" STRUCTURE.**
    - **TRADITIONAL, NEWTONIAN, ANALYSIS METHODS APPLY.**

  - **BOUNDARY (LIQUID) - EMERGENT BEHAVIOR "WHIRLPOOLS"**
    - **COMPLEXITY SCIENCE.& OPEN SYSTEMS ANALYSIS METHO**
    - **ADAPTATION, EVOLUTION, CHANGE.**
    - **STRUCTURES EXHIBIT, HOMEOSTASIS, RESILIENCE.**

  - **CHAOS (GAS) - "EXTREME SENSITIVITY" TO INITIAL**

WARFARE

A COMBINATION OF

"OPEN & CLOSED" PARADIGMS

- COMMAND AND CONTROL & COMMUNICATI
- "FOCUSED LOGISTICS" & TPFDD AND DEPOT
  BASED LOGISTICS.
- FORCE PLANNING FOR "ADAPTIVE" THREATS
  - "THREAT" vs "CAPABILITY" BASED FORCE DESIGN.
  - "SCENARIOS" vs CO-EVOLVING FITNESS LANDSCAPE
- BUDGET PLANNING.
  - "KNAPSACK" PROBLEM vs.SURVIVAL & ADAPTATION
    ON AN EVOLVING FITNESS LANDSCAPE.

STATE OF DEFENSE ANALYSIS METHODOLOGY

- **DOMINATED BY LEGACY OF THE "CLOSED SYSTEM" PARADIGM.**
  - **"NEWTONIANISM" DETERMINISTIC CAUSE & EFFECT.**
  - **"REDUCTIONISM" DISASSEMBLE THE WHOLE, UNDERSTAND THE PIECES, REASSEMBLE TO UNDERSTAND THE "WHOLE".**

- **USE OF "REALISM PAINT" TO MAKE A "CLOSED" MODEL LOOK MORE "REALISTIC".**
  - **STOCHASTICS TO FUZZ THE BEHAVIOR**
  - **MORE DETAIL; THE ENDLESS QUEST.**

- **INCREASED USE OF GAMING AND FACILITATED SEMINARIN IN COMBINATION WITH CLOSED PARADIGM M&S.**

EXAMPLE
CLOSED vs OPEN SYSTEM ANALYSIS

WWII SUBMARINE SEARCH:

THE "SYSTEM" = GERMAN ATLANTIC SUBMARINE OPERATIONS

REAL WORLD SUBMARINE PRESENCE PERCEIVED

-RADIO REPORTS ATTRIBUTABLE TO SPECIFIC SUBNMARINE
-UNATTRIBUTABLE RADIO TRAFFIC FROM SUBS.
-TORPEDO HITS ON CONVOYS.
-RECCE & INTEL FROM SUB BASES .
-PHYSICS OF SUBMARINE PERFORMANCE.
-INTEL AND EXPERTISE ON SUBMARINE ORGANIZATION, OP
-GOOD KNOWLEDGE OF MY OWN SENSING CAPABILITIES.

LOTS OF ENERGY FLOWING FROM THE SYSTEM: C

SYSTEM HAS GOALS & MOTIVATIONS; STRUCTURE, IT BEHAVES & I

CLOSED SYSTEM ANALYSIS APPROACH

QUESTION: HOW MANY SUBS ARE DEPLOYED?

APPROACH: DEFINE A CLOSED SYSTEM AND PRED
ITS CHARACTERISTICS.

-CLOSED SYSTEM:

- USE ONLY THE RADIO REPORTS ATTRIBUTABLE TO SPECIFIC BOATS.

-IGNORE THE REST OF THE ENERGY PASSING THROUG THE SYSTEM, (THE SIGNATURES OF THE REAL SUBM OPERATING STRUCTURE)

-ASSUME A POISSON DISTRIBUTION. (UNIFORMITY AS

5 SUBS REPORTED 1 TIMES.
3 SUBS REPORTED 2 TIMES
2 SUBS REPORTED 3 TIME.

PREDICTIONS: THERE ARE 2 SUBS NEVER HEARD/ 12 SUBS

NEXT QUESTION:HOW DO WE BEST FIGHT THESE S

-HEART & SOUL OF EFFECTS BASED WARFARE ANALYSIS.

OPEN SYSTEM ANALYSIS APPROACH

AGENT BASED SIMULATION.

-TREAT CONVOY SHIPS AS "AGENTS (SCRIPTED)

-DEFINE SUB "AGENTS". (TUNE DETAIL FOR REALIST BI

- USE GENETIC ALGORITHMS TO "BREED"SUBM FORCES AND OPS CONCEPTS

-SUB CHARACTERISTICS (PRETTY GOOD BOUNDARIES)

-C2 STRUCTURE (REPORTING RULES)

-MOTIVATIONS (SINK SHIPS & DON/T GET SUNK)

-OPS CONCEPTS (CRUISE DURATION, REPLACEMENT SCHEMES ,OPS

-AS SUB OPERATING STRUCTURES EMERGE FROM SUB AG INTERACTIONS WITH CONVOYS,SEARCH EFFORTS, PHY

-TEST THOSE EMERGENT SUBMARINE "STRUCTU

-COMPARE ITS PERCEIVABLE "SIGNATURES" (RADIO TRAFFIC TORPEDO HITS, PORT INTEL REPORTS, ETC) TO REAL EXPE

-OBSERVE "BEST FIT"OF AGENT MODEL TO REA

-NOW SPECULATE ON: HOW MANY, HOW TO FIGH

CLOSED vs OPEN SYSTEM COMPARISON

CLOSED SYSTEM APPROACH:

- DEFINED A STRUCTURE; ITS SHAPE & BEHAVIOR- OUR "MODEL
- CLOSED THE BOUNDARIES OF OUR INVESTIGATION.
  - -WORKED WITH A FIXED SUBSET OF THE INFO AVAILABLE
  - -IGNORED DATA THAT DID NOT FIT THE "MODEL".
- -LEARNED VERY LITTLE OF WHAT THERE WAS TO KNOW ABOUT GERMAN SUBMARINE BEHAVIOR.
- -WE FIT THE WORLD TO OUR DESIGN; NOT ASKING WHAT MIGHT EXPLAIN WHAT WE WERE SEEING; USING ALL OF WHAT WE WE NOT CONSIDERING HOW IT MIGHT RESPOND TO SOMETHING W

OPEN SYSTEM APPROACH:

- -LET A STRUCTURE "EMERGE" FROM THE POSSIBLE INTERACTION --"SELF ORGANIZATION"- IT DEFINES ITS "BEST" SELF.
- -USE ALL THE INFORMATION AVAILABLE TO TEST EMERGENT STRU
  - -HAVE A TOOL FOR UNDERSTANDING THE "WHOLE" OF THE ENEM AND WHAT MIGHT HAPPEN NEXT--EXPLORE ADAPTIVE BEHAVI
  - -HAVE A METHODOLOGY FOR EFFECTS BASED WARFARE

CHALLENGES

- **WHAT IS THE VALUE OF ANALYSIS OF "OPEN SYSTEM" ISSU**
  PERFORMED WITH CLASSIC "CLOSED SYSTEM" METHODOL

HOW DO WE RECOGNIZE, DESCRIBE& ANALYZE "OPEN SYSTE
ISSUES?

- **WHAT IS IMPORTANT TO KNOW ABOUT "OPEN" MILITARY S**
  BEHAVIOR?

- **WHAT CAN WE REASONABLY TELL DECISION MAKERS ABO**
  "OPEN" PROCESSES AND THEIR CONSEQUENCES?

- **WHAT CAN WE LEARN FROM COMMERCIAL USES OF**
  COMPLEXITY SCIENCE & OPEN SYSTEM ANALYSIS?

- **WHAT IS THE "RIGHT WAY" TO USE THE COMPUTER?**
  - **AGENT BASED SIMULATION**
  - **BREEDING & TESTING STRUCTURES vs DEFINING "THE**